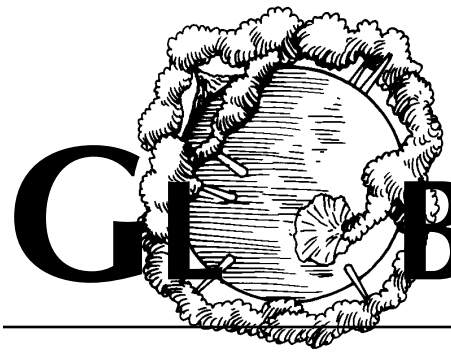


Unit 3
GLOBAL CHANGE

Global Environmental Impacts

Introduction

To recognize the impact of human activities on the Earth system, students should be introduced to some of the changes affecting the whole planet. This unit illustrates examples of land-use changes and global warming and cooling. Students' model Earth terrariums will be used to demonstrate the greenhouse effect and the difference between global warming and cooling. Global change is a complicated subject even for scientists. An integrated approach to Earth science research is needed to understand how local and regional impacts can become global-scale environmental problems.

Materials

Terrarium or jar, and U. S. maps showing coasts.

Objectives

The student will be able to:

- Associate global change vocabulary words with pictures of environmental changes.
- Recognize that human activities are a force of global change on Earth (desertification, disappearance of forests, air pollution, global warming).
- Demonstrate that changes to one of the components in the terrarium can cause changes to all the components.
- As a member of a team, demonstrate how the terrarium is a greenhouse.

Visuals

NASA Lithograph: Water is a Force of Change

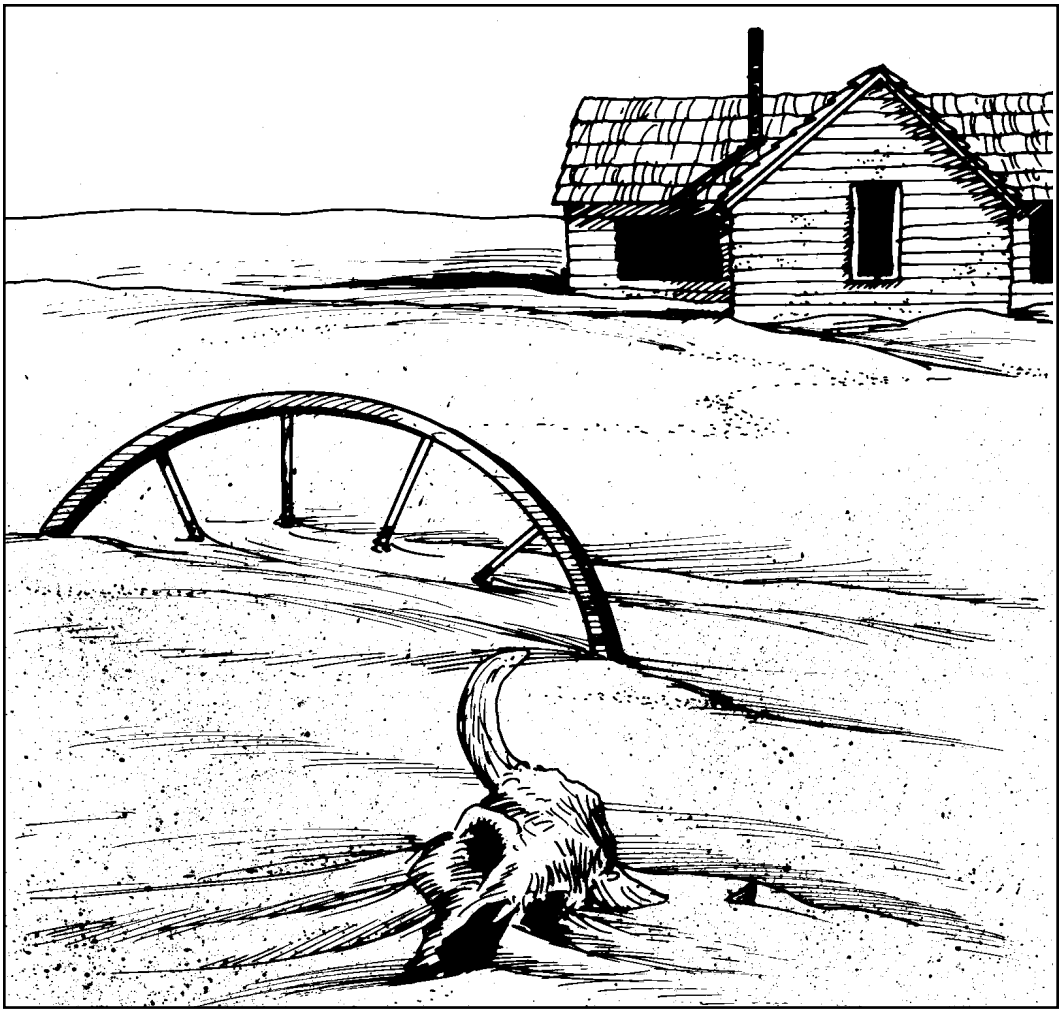
Vocabulary

Deforestation	Greenhouse	Rain Forest
Desert	Pollution	Volcanoes
Global warming		

Land-Use Changes

Deserts occur naturally, but people also help to create them. In their search for more farmland, people around the world have pushed into areas that naturally supported only grasses and shrubs, like the Midwestern prairie. These plants, with their deep root mat and/or succulent leaves and stems, adapt to periodic drought. However, when farmers plowed under these plants and planted food crops that depended on greater rainfall and richer soil, they damaged the area's natural balance.

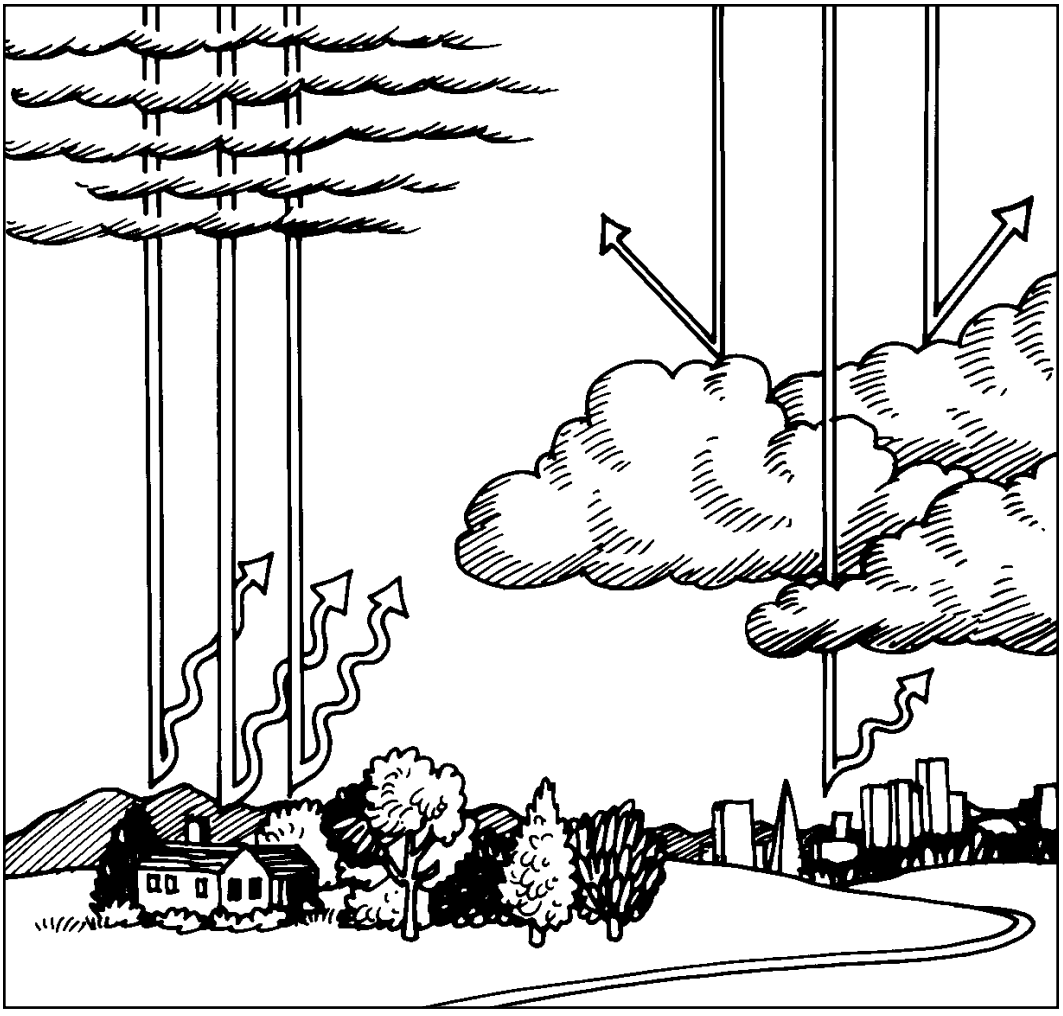
During short-term droughts, these ill-adapted crops failed to hold water and large areas dried out. Livestock worsened the situation. Confined by humans to pastures, they overgrazed and killed the roots of native grasses. When rain did come, it washed away the mineral-rich topsoil. The farmers eventually moved on, leaving behind unproductive, dry land. The photo of the Sinai Peninsula in Algeria shows what deserts look like from space. Some of the desert lands in the Middle East were fertile farmlands a few thousand years ago.



Greenhouse Effect

In recent history, human activities have increased significantly the amount of greenhouse gases in the atmosphere. These gases—carbon dioxide and ozone—allow the Sun's light to pass through the atmosphere and heat the land and oceans. They also reflect ground-generated heat that otherwise would escape into space. A similar kind of warming happens in a greenhouse or glass-covered terrarium when the glass traps heat inside. Scientists have used computer models to predict that global temperatures could rise as much in the next 100 years as they have over the last 18,000 years.

High and low clouds reflect and pass light differently. High, thin (cirrus) clouds are like the glass in the jar or terrarium; they let radiation pass through, but do not let heat out. Low, thick (stratocumulus) clouds, on the other hand, are cooling clouds; they reflect light away before it reaches the ground.



Observation

Terrarium Observation: Part 5, The Greenhouse.

Fill a terrarium or glass jar with dark soil; place a thermometer inside; cover the terrarium; and place it in the sunlight for one hour. Take the temperature inside the glass terrarium and compare it to the temperature of the room. Temperatures are warmer inside the terrarium. Explain what has happened. The air inside the glass containers represents the atmosphere, and the dark soil, land. When the soil is heated by the sunlight, the radiated heat is trapped by the glass, creating a greenhouse effect.

Field Trip

Visit a Greenhouse.

If possible on a cold sunny day, visit a local greenhouse, zoo with a jungle habitat, botanical garden, or solar-heated atrium. Students can feel what it is like to be inside a greenhouse. Have the students identify the life-supporting components. What cycles can they identify? Ask them to compare the greenhouse to their terrarium and to the whole Earth.

Activities

Global Warming Map.

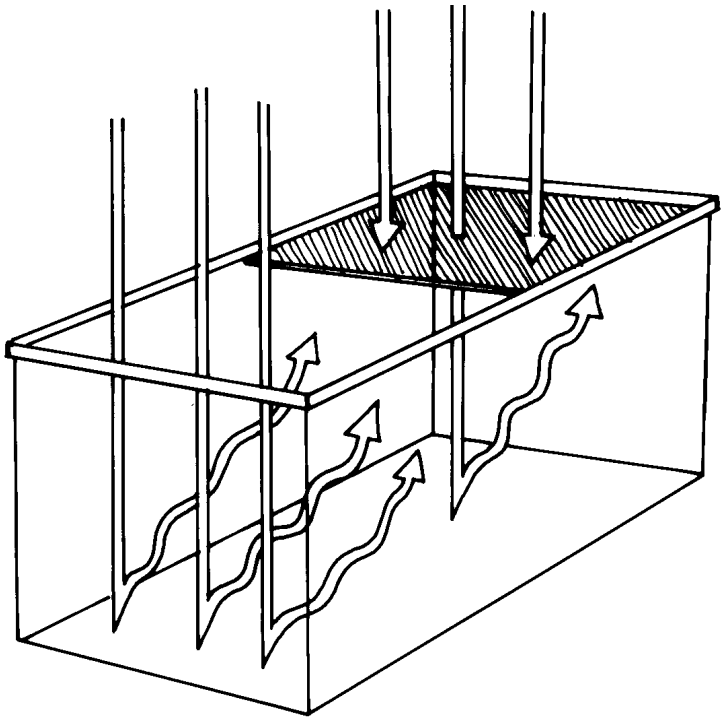
Discuss with students how a temperature change of a few degrees could drastically change our world. If global temperatures rise, the heat would melt glacial ice and raise sea levels (see glacier photograph in the lithograph, "Water is a Force of Change). What would happen to us if all the world's coasts flooded? On a U.S. map, identify some of the coastal cities (low-lying areas) that might be covered with water if sea levels rise. What would happen inland to cities and farms if the climate became warmer? Are there other ways people's lives would change due to global warming in your area? It is okay to speculate.

Global Warming Mural.

Have students draw a picture of the places around them after global warming has taken place. Display the pictures as part of a mural on "Global Warming." The pictures could be mounted on a map of the world.

Global Cooling

Naturally occurring volcanic eruptions and large forest fires can impact the Earth's system just like human-caused air pollution. These events can fill the atmosphere with dust and darken the global "greenhouse roof," which results in cooling. This is why scientists must study Earth as a system to understand how the planet is changing beyond these natural events.



Observation

Terrarium: Part 6, Global Cooling.

Cover the terrarium with smoked or dirty glass or colored plastic wrap. Place it in the sunlight and take the temperature inside the terrarium after an hour. In the same way that volcanic dust or air pollution has a cooling effect on the atmosphere, the temperature will not increase as much as it did when the clear glass was used to cover the terrarium (Terrarium Observation, Part 5).

Global Cooling.

Examine photos that show urban pollution, volcanic explosions, Amazon basin fires, and wildland fires in the Los Angeles area. These are sources of air pollution that have a cooling effect on Earth's atmosphere. Show photos of the human activities that cause air pollution and fires. Discuss how people could change their behavior and technology to prevent air pollution.